Serial No.: 10/661,576
Atty. Docket No.: P69053US0

IN THE SPECIFICATION:

Please amend the text beginning on page 6, line 3, through line 37:

--Prior methods proposed for lowering the saturation degree of pore water (water in porous voids of ground) contained in a ground where the saturation degree is defined to be the ratio in percent of the volume of pore water to the total volume of porous void in the ground is further divided into the method of lowering ~~methods to lower~~ ground water level by means of deep wells ~~well~~ and the like, and the method of blowing compressed air into the ground.

By said method utilizing deep ~~well~~ wells or the like, the ground water is pumped out for lowering the groundwater table.

This method involves the problem of land subsidence due to the consolidation of soft strata caused by the lowering of the ground water table and thus its application to built-up urban areas is impracticable.

The present invention belongs to said method D among the countermeasures for preventing seismic liquefaction of ground without any of the ~~disadvantage involved in~~ disadvantages associated with the prior ~~method~~ methods of lowering the saturation degree of pore water in the ground.

Those methods patented by the United States Patent and Trademark Office that ~~falls~~ fall into the above mentioned category and sorted out of the U.S. patent data base ~~U.S. Pat. No. 5,927,907 "Method and apparatus for preventing liquefaction of ground caused by violent earthquake"~~ by the courtesy of Jotaro Iwabuchi, Ph.D. PE meeting the demand of the claimant for the patent of the present invention, are as follows: U.S. Pat. No. 5,927,907 "Method and apparatus for preventing liquefaction of ground caused by earthquake", U.S. Pat. No. 5,868,525 "Method of preventing damage to loose sand ground or sandy ground due to seismic liquefaction phenomenon, and of restoration of disaster-stricken ground", U.S. Pat. No. 5,800,090 "Apparatus and method for liquefaction remedy of liquefiable soils", and U.S. Pat. No. 5,779,397 "Method of improving against vibration and liquefaction".--

On page 8, please the second full paragraph beginning on line 17, as follows:

--There are a number of patented methods for preventing seismic liquefaction of ground similar to the one described above.--

On page 10, please amend the last paragraph as follows:

--These ~~bubbled~~ bubbles out of said tap-water swarming around cores of micro ~~particle~~ particles of said mineral powder lower the saturation degree therein ~~in it~~ down to the level at which no seismic liquefaction takes place even at the time of a violent earthquake.--

On page 11, please amend the third paragraph beginning on line 11, as follows:

--Both of the top well and the bottom well are packed fully with permeable material, ~~being~~ each one of them being placed in a top permeable section and a deep permeable section, respectively, and the middle well packed fully with an ~~such~~ impermeable material such as bentonite paste being ~~in~~ placed in the middle impermeable section.--

On page 11, please amend the seventh paragraph as follows:

--The holes for the middle well and the bottom well may be bored such that the diameter of these wells is ~~will be~~ approximately half the diameter of the holes for said top well.--

On page 12, please amend the fourth and fifth full paragraphs beginning on line 29, into a single a single paragraph, as follows:

--A longitudinal perforated pipe is built along each one of the side peripheries of said range of area~~. By~~ by forming a hardly-permeable barrier ~~consist~~ consisting of countless micro air bubbles fed up out of said perforated pipe with downward opening perforation, installed by means of ~~such~~ a pipe-pushing machine such as used in small-diameter pipe pushing method or the like.--

On page 13, please amend the second full paragraph beginning on line 12, through page 16, line 2, as follows:

--A seventh object of the present invention is in providing a method for preventing seismic liquefaction of ground as defined by the first object, the second object, the third object, the fourth object, the fifth object and/or the sixth object mentioned afore to prevent pumping out groundwater in excess of a predetermined minimum rate by interrupting the pumping of groundwater out of loose fine grained layer as soon as the flow-rate sensor placed inside said top well and linked electronically to the means driving said submerged pump detects a flow rate in excess of the predetermined rate.

An eighth object of the present invention is in providing a method for preventing seismic liquefaction of ground as defined by the seventh object mentioned afore comprises providing an air compressor installed on the ground surface where the air-tight tank and an air compressor are connected to each other with an air pipe inserted in between them with an air check valve for holding a reverse flow of overly compressed air. The ~~whereas the~~ air-tight tank is connected with pipes to the submerged pumps installed in rows of the top well through a main water pipe with a water-check valve inserted in between them.

A reverse flow main pipe extends down into the bottom well from the air-tight tank, with a water main valve being inserted in between them.

~~During while~~ While the submerged pumps are driving, the pumped out groundwater is pushed up into said air-tight tank and pressurized water is made to flow through the open main valve, and into the reverse flow main pipe down into the deep permeable section surrounding the bottom well until the means driving the submerged pumps ~~interrupt~~ interrupts its operation when the water-pressure sensor placed in the main water pipe linked electronically to the means driving the submerged pumps detects the rise of pressure in excess of a predetermined level.

The operation of submerged pumps is interrupted, closing the main valve of the reverse flow main pipe so as to suspend the flow of pressurized water into the deep permeable section.

As soon as the pressure sensor placed in the air-tight tank linked to the driving means of the air compressor detects the lowering of the pressure in said tank lower than predetermined level, the operation of the air compressor is resumed to raise the pressure in said air-tight tank and the main valve is opened to force compressed air to blow out the clog ~~clogging~~ formed by accumulation of dusty particles in the layer surrounding the bottom well, thus removing the choking of said ~~clogging~~ clog.

Then soon after the water-pressure sensor detects the rise of pressure in the main water pipe back to the predetermined level, the pumping of groundwater out of the loose fine grained layer by the submerged pumps is resumed and the flow of said pressurized water into the deep permeable section is resumed.

Thus the repeated cycles of pumping groundwater out of the loose fine grained layer and forcing the pumped out water flow down into the deep permeable section with intermittent blowing of compressed air into the clogged pore voids of the deep permeable section are made during ~~while~~ the first stage of dewatering the loose fine grained layer in the top permeable section as defined in

the first object of the present invention of a method for preventing seismic liquefaction of ground.

A ninth object of the present invention is in providing a method for preventing seismic liquefaction of ground as defined by the seventh object of the present invention is to prevent blowing an excessive amount of compressed air into the deep granular layer surrounding the bottom well by interrupting the driving air compressor to suspend blowing compressed air soon after the flow-rate meter linked electronically to the means driving the air compressor detects the rise of flow-rate in excess of the predetermined rate. This control is desirable because countless ~~Countless~~ micro capillary tubes are pierced into the ~~clogging~~ clog of dusty particles, being formed to raise the flow-rate of compressed air blowing into the bottom well, ~~to~~ which can cause occurrence of nasty sewage odor or harmful oxygen-short air.

A tenth object of the present invention is in providing a method for preventing seismic liquefaction of ground as defined by the first object, the second object, the third object, the fourth object, the fifth object, the sixth object, the seventh object, the eighth object and/or by the ninth object of the present invention mentioned afore to achieve applying the present method for preventing seismic liquefaction of ground without interrupting

the function of such a public facility as a street by accommodating such buried pipes as the main water pipe, reverse flow main water pipe, supply water pipes and the like by laying them within the periphery of an area for executing the method of the present invention, specifically in each one of the side ~~ditch~~ ditches laying along each side of the roadway and the cross ditch of the roadway. Every ~~every~~ ditch is ~~being~~ covered with a cover board while ~~by making such a~~ equipment on the ground surface such as an air-tight tank~~,~~ or an air compressor is small and ~~low headed~~ mounted on a trolley to have a low clearance for ~~the~~ freedom of movement, thereby ~~for~~ adapting ~~the~~ the present invention for use in densely built-up urban areas where there is a low head clearance placed on the loose fine grained ground.

These together with other objects ~~object~~ and ~~advantage~~ advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed. Reference~~, reference~~ is made to the accompanying drawings forming a part hereof, wherein numerals refer to the parts denoted in the following description[[:]].--

On page 16, please amend the text beginning on line 4 after the title and through page 18, line 36, as follows:

--Figure 1 is a ~~projective~~ perspective front view illustrating schematically an example of the ~~equipments~~ equipment placed on and the pipes placed below the pavement of a street in a densely built-up urbanized area occupied by rows of vehicular traffic for executing the method of the present invention.

Figure 2(a) is a cross sectional view on the vertical sectional plane extending through the center lines of horizontal main water pipes and vertical branch water pipes illustrating schematically an example of the ~~equipments~~ equipment placed on and buried pipes in a well below the pavement of a street in a densely built-up urbanized area occupied by rows of vehicular traffic at the stage before the groundwater in said loose fine grained layer is pumped out for executing the method of the present invention.

Figure 2(b) is a side sectional view along the center line of ~~one of~~ the roadway as illustrated in Figure 2(a).

Figure 3 is a cross sectional view as illustrated in Figure 2(a) at the stage before the groundwater in the loose fine grained layer is pumped out when the ~~clogging~~ clog formed ~~during~~ while the bottom well is bored and/or at the stage soon after the flow rate of groundwater pumped out of said loose fine grained layer is lowered below a predetermined rate. An ~~an~~ air compressor linked to a flow-meter automatically starts blowing compressed air

through an air check valve, an air-tight tank, a main valve, a reverse flow main pipe and a reverse flow branch pipe down into the ~~clogging~~ clog formed by dusty particles drawn out of the loose fine grained layer together with the groundwater pumped out of it and the compressed air thus blown onto said ~~clogging pierce~~ clog pierces into the countless micro capillary tubes into the ~~clogging~~ clog to clear the choking around the bottom well so as to resume the original rate of water flow.

The cycle of intermittently supplied compressed air reciprocally with the pumped groundwater ~~pumped into~~ is repeated every time ~~when~~ it is required for executing the pumping out stage of the method of the present invention.

Figure 4 is a cross sectional view as illustrated in Figure 2(a) at the stage shortly after the pumping out of the groundwater from said loose fine grained layer is resumed and the compressed air is blown down into the deep granular layer for executing the pumping out stage of the method of the present invention.

Figure 5 is a cross sectional view as illustrated in Figure 2(a) at the stage where the groundwater table in the loose fine grained layer is lowered down to a ~~the~~ level that is approximately a quarter of the depth of said loose fine grained

layer for executing the pumping out stage of the method of the present invention.

Figure 6 is a cross sectional view as illustrated in Figure 2(a) at the stage where the groundwater table in the loose fine grained layer is lowered down to the level midway of the depth of said loose fine grained layer for executing the pumping out stage of the method of the present invention.

Figure 7 is a cross sectional view as illustrated in Figure 2(a) at the stage where the groundwater table in said loose fine grained layer is lowered down to the level that is three ~~quarter~~ quarters of the depth of said loose fine grained layer for executing the ~~said~~ pumping out stage of the method of the present invention.

Figure 8 is a cross sectional view as illustrated in Figure 2(a) at the stage where the groundwater table in said loose fine grained layer is lowered down to the level ~~nearly~~ close to the bottom of said loose fine grained layer for executing the ~~said~~ pumping out.

Figure 9 is a cross sectional view as illustrated in Figure 2(a) after the air compressor, the air check valve, the air-tight tank, the reverse flow main pipe placed on the pavement of a street and the main valve are removed to be replaced with a

supply water tap and a regulating tube through which said tap-water supply begins to flow ~~permeating~~ to permeate into said loose fine grained layer for executing said refilling stage of the method of the present invention.

Figure 10 is a cross sectional view as illustrated in Figure 9 showing the refilling stage for executing the method of the present invention shortly after the foremost ends of said tap-water, permeating into said loose fine grained layer out of both sides, meet together.

Figure 11 is a cross sectional view as illustrated in Figure 9 showing the stage for executing the method of the present invention shortly before the foremost ends of said tap-water permeating into said loose fine grained layer touch down at the bottom end of said loose fine grained layer.

Figure 12 is a cross sectional view as illustrated in Figure 9 showing the stage for executing the method of the present invention shortly after the foremost ends of said tap-water permeating into said loose fine grained layer touch down at the bottom level of said loose fine grained layer ~~being~~ in which countless tiny air bubbles come out in the pore voids of said loose fine grained layer.

Figure 13 is a cross sectional view as illustrated in Figure 12 showing the state of the ground after all those facilities used for executing the method of the present invention ~~are~~ have been removed and the hollow spaces where the ditches and well ~~are~~ have been removed ~~out~~ are filled back tightly to recover the original density of the ground before said facilities were ~~are~~ installed.

Figure 14 is a cross sectional view illustrating an example where the method of the present invention is applied to a container wharf where such pipes as main water pipe and reverse flow main pipe may be placed on the pavement covering the ground surface ~~being~~ in which a short portion of those pipes covered is covered with a cover board. Therefore, it is much easier to set or to remove those parts used for the method of the present invention than where said method is applied to a street.--

On page 19, please amend the text beginning with the third paragraph on line 21, through page 20, line 19, as follows:

--Otherwise, ~~any~~ air does not ~~neither~~ dissolve out of said tap-water even though said tap-water is overly saturated with air, and no ~~nor any~~ air bubbles form ~~bubble forms~~ in said tap-water.

The present invention is particularly suitable for ~~the~~ application to such a place as an urban street and/or a harbor area where the space over the ground surface is used for such ~~a~~ busy activity as traffic and/or as cargo handling work. The present invention is also well suited to ~~as well as to such a~~ ground under the water of gently streaming river.

The present invention is most suitably applicable to such a place as an urban street and/or a harbor area in a densely built-up area where the ground below such a place is formed with loose fine grained fill overlaying a soft cohesive layer like the one called New Bay Mud underlain by a deep granular layer prevailing along the sea shore of the West Coast of North American Continent where there is one of the most active earthquake zones ~~zone~~ in the World stretching along the San Andreas Fault extending from its northern end in Alaska all the way down southward to Mexico.

Because the facilities used for achieving the object as defined by the first object of the present invention are handy and easily retrievable, the method of the present invention is particularly suitable for the application to said urban street and/or a harbor where the space over the ground surface is used for

~~such an~~ busy activity as ~~traffic and/or as harbor works~~ described afore.

The present invention is also suitably applicable to such a place as below a viaduct of low head clearance as well as on a narrow space ~~of~~ <u>such as</u> a lane where any heavy duty equipment like a crawler mount pile driving machine is not permitted to approach.

The present invention is further applicable to a sub-aqueous place without using any ~~such a~~ floating equipment <u>such as</u> ~~a~~ heavy duty pushers and/or barges like the ones used for building the Trans Bay Tube for sub-aqueous rail tunnels crossing San Francisco Bay by Bay Area Rail Transit in or around 1965 through 1975.--

On page 21, please amend the first full paragraph beginning on line 12, through page 24, line 7, as follows:

--In addition to the above report, it should be mentioned that, despite the <u>loose fine grained</u> ground surrounding 305 pneumatic caissons supporting viaducts, bridges and a blast furnace ~~was loose fine grained one~~, those structures could endure the violent tremor, the maximum horizontal acceleration of which was so high as ~~being~~ <u>to be</u> close to the acceleration of gravity caused by Hyogoken Nambu Earthquake of 1995, without fatal damage, while a

great many number of other such structures, including ~~as~~ viaducts, bridges, buildings and the like built on such foundations as piles, open caissons or the like were fatally damaged by said Earthquake.

It was verified, that the forming of countless micro capillary tubes made piercing into the clogged pore voids as defined in the fourth object of present invention described in ~~ongoing~~ foregoing paragraphs by the result of an experiment made ~~maid~~ by said Kiso Jiban's laboratory in Tokyo under the contract owned personally by the claimant for a patent of the present invention.

The sample of sandy gravel, ~~being~~ its pore voids filled up with boring mud at the pressure of 0.07 MPa (0.7 kgf/sq. cm) in an air-tight container of acrylic tube 10 cm in inside diameter and 50 cm high containing, from the top end down, a synthetic rubber ~~lubber~~ top board tightly fixed down to the top end of said acrylic tube, a 20-cm deep water, said sample of boring mud 30 cm deep underlain with a porous stone board and a synthetic lubber bottom board tightly fixed up to the bottom end of said acrylic tube with a drain hole, was placed on a testing table.

The compressed air pressurized at 0.12 MPa was allowed to ~~let~~ flow into said acrylic tube through a pipe built in the top board to replace said 20-cm deep water being pushed out through the

relief valve built also in said top board until the vacant space below said top board was filled up with compressed air.

Then, the compressed air pushed into said boring mud to let it bore countless micro capillary tubes pierced through said mud, filling the pore voids of said sample of sandy gravel, and the air pushed in through said capillary tubes blew out downward through said porous stone board.

By the result of above experiment, it was made clear the compressed air at the pressure not higher than 0.12 MPa pierces countless micro capillary tubes into such a wet muddy clog choking pore voids of granular ground similar to said sample of sandy gravel ~~being~~ in which its pore voids were filled up with boring mud.

~~Most~~ The most popular siliceous material that is chemically stable and harmless in and suitable to underground use extensively and available everywhere in the world is silicon dioxide or silica. Silica is a principal component of crystallized volcanic ash. It exists in a more purified form as quartz, crystal and the like.

Before describing the details of applying the present invention, it must be noted that the property of said fine grained layer is not as uniform as assumed in composing the procedure of

applying the method of the present ~~invented~~ invention. Even in rather uniform alluvial ~~deposit~~ deposits there are patches of loose ~~spot~~ spots or ~~week~~ weak strips.

In relatively uniform media, the groundwater does not permeate as uniformly as the theory of steadily permeating flow may ~~suggests~~ suggest. Instead, a ~~A~~ phenomenon called fingering makes several water heads of finger like shape permeate much faster through loose ~~stripes~~ strips than said theory may ~~suggests~~ suggest. This sort of irregularity is exaggerated in reclaimed ground.

In a broad extent of reclaimed fill there are a number of zones ~~wherein~~ in which the fast permeating finger tips of flow reach their final goals far ~~much~~ ahead of slow permeating tips of flow ~~reach their final goals~~.

In the United States where the coefficient of permeability in the shallower zone of said loose fine grained layer is smaller than the one in the deeper zone, the final goal whereat any one of those fingering flow tips of water may touch ~~up~~ may be the bottom base level of street pavement. However, the hydraulic pressure in every zone is kept steadily at the predetermined level until the time when the last finger ~~tips~~ tip of said permeating flow reaches its goal. The flow rate may then be diminished to a minimum when said last water tip reaches its goal.

Soon after diminishing of the flow rate ~~diminished~~ to minimum rate is detected by said water-flow meter, then the supply water valve is closed to make the head level of said tap-water fall down to the initial groundwater level so as to form an air-mixed zone of countless tiny air bubbles in the pore water of loose fine grained layer as defined in the first object of the present invention ~~described in ongoing paragraphs~~.

Also, before describing an example of an application of the present invention, ~~it should be mentioned that~~ the difference in grain size distribution of said loose fine grained layer between the coastal cities facing the eastern seashore of Japan and of said loose fine grained layer prevailing along the seashore of the West Coast of the United States should be mentioned.

The grain size distribution of said loose fine grained layer in said coastal cities of Japan is the result of a natural deposit in geological history of world wide rising sea water surface during the ending period of the last glacial epoch where the grain size in shallower depth is not finer than the one in greater depth.

~~Whereas~~ By contrast, the grain size of said loose fine grained layer prevailing along the West Coast sea shore of the United States is reclaimed fill, ~~except~~ with the exception of a

very rare case of natural deposit, where the grain size in shallower depth is finer than the one in greater depth.--

On page 24, please amend the fifth full paragraph beginning on line 22, through page 26, line 11, as follows:

--The rows of ~~well~~ wells 5 placed at a predetermined interval along both side lines of the roadway running through street 1 being the method for preventing seismic liquefaction of ground to be executed in the boundary in between the both outside lines of the street 1 are bored down into the deep granular layer 4.

Said ~~well~~ wells 5 ~~comprises a~~ include rows of top ~~well~~ wells 6 extending down through the loose fine grained layer 2 into the top portion of soft cohesive layer 3, the rows of middle ~~well~~ wells 7 extending down from the bottom of the top ~~well~~ wells 6 to the bottom portion of the soft cohesive layer 3 and the rows of bottom ~~well~~ wells 8 extending down from the bottom end of the middle ~~well~~ wells 7 into deep granular layer 4.

In an example of application of the method of the present invention, the holes forming top ~~well~~ wells 6 are to be bored by ~~such~~ a boring method for boring holes without disturbing the ground surrounding the bored holes such as All Casing Method labeled in

Japan or by ~~such~~ a boring machine like the one once made by the ~~an~~ Italian firm Benoto or the one labeled Reverse Circulation Method. The ~~and the~~ holes forming the middle ~~well~~ wells 7, the diameter of ~~it is~~ which are approximately ~~a~~ half the diameter of top ~~well~~ wells 6, may be bored by a boring machine used for boring holes of deep ~~well~~ wells or the like.

However, the method for boring holes of ~~well~~ wells 5 should be selected to suit the work site situation, for instance in a densely built-up urban area, to avoid using tall machines in the site where the head clearance is low and to suitably select using low head machines suitable for the use under a low head clearance.

In top well 6 of said well 5, submerged pump 9 is coupled ~~up~~ to the lowest end of branch water pipe 11 ~~being~~ which is tied up to main water pipe 10 connected upward to air-tight tank 13 where water check valve 12 is inserted shortly below the low end of air-tight tank 13 placed on the ground surface at ~~and~~ the most adequate position in the work site.

At the position immediately below water check valve 12 inserted in water main pipe 10, is a water-flow sensor (not shown) linked electronically to the means (not shown) for regulate driving submerged pump 9.

A pressure sensor (not shown) is set inside air-tight tank 13. Rows of reverse flow branch pipe 15 tied up to reverse flow main pipe 14 ~~extending~~ extend down into bottom well 8, the lowest portion of which is perforated to convert it into perforated pipe 16.

A reverse flow main pipe 14 is coupled to said air-tight tank 13 through a main valve 17 inserted in between them.

An air compressor 18 placed near air-tight tank 13 is connected to air-tight tank 13 ~~being~~ with an air check valve 19 inserted in between them.

The means (not shown) for operating the air compressor 18 is linked electronically to the pressure sensor set inside air-tight tank 13.

~~And an~~ An air-flow rate meter (not shown) is installed in between air compressor 18 and air-tight tank 13.

As illustrated in Figure 2, main water pipe 10 and reverse flow main pipe 14 are placed in each side ditch 20 formed along both sides of the roadway of street 1 and in a cross ditch 21 formed across the roadway of street 1.

Because both ~~of~~ the side ~~ditch~~ ditches 20 and cross ditch 21 are covered with cover board 22, ~~it does~~ they do not obstruct any free movement of traffic on the roadway of street 1 ~~during~~

while the method for present seismic liquefaction of ground is executed.--

On page 26, please amend the last paragraph as follows:

--A couple of longitudinal perforated ~~pipe~~ pipes 26 are installed by a small-diameter pipe pushing method or the like stretching along each outside boundary of street 1 covering the area which is the object of executing said method of the present invention for preventing seismic liquefaction of ground at the depth close to the top level of soft cohesive layer 3.--

On page 27, please amend the first paragraph as follows:

--An adequate amount of pressurized water containing countless micro air bubbles produced by means (not shown) installed on the ground surface is supplied into said longitudinal perforated pipe 26 for blowing out to form a ~~hardy-permeable~~ hardly-permeable micro air bubble barrier 27 similar in shape to an inverted upside-down curtain formed by countless micro air bubbles which is ~~maid~~ made in loose fine grained layer 2 alongside or close to each outside periphery of the street 1 by blowing said pressurized water containing countless micro air bubbles out of said longitudinal perforated pipe 26 upward.--

On page 27, please amend the fourth paragraph beginning on line 22, through page 29, line 18, as follows:

--As shown in Figure 3, compressed air is supplied from air compressor 18 through air check valve 19 into air-tight tank 13. When the pressure in air-tight tank 13 rises up to a predetermined level and is detected by a sensor, main valve 17 of reverse flow main pipe 14 is made open to make compressed air flow through reverse flow main pipe 14, and reverse flow branch pipe 15 to blow out of perforated pipe 16 installed in bottom well 8 bored into deep permeable section 25.

~~By the~~ The blowing of compressed air ~~thus blown~~ out of perforated pipe 16 forms countless micro capillary tubes into the ~~clogging~~ clog filled with drilled dust formed by drilling the bored hole of well 5.

As a result of the above forming of said capillary tubes, permeability of the clogged portion of deep permeable section 25 is raised to rapidly increase the flow rate of compressed air blowing into deep permeable section 25.

As soon as the air-flow meter of air compressor 18 ~~detect~~ detects the rapid increase in air-flow rate rising up to the predetermined rate, the operation of air compressor 18 is interrupted in order not to feed an excessive amount of compressed

air. Controlling the amount of compressed air is partly for preventing the forcing of harmful gas or odor of sewage and the like ~~to come~~ up out of the ground, partly for reducing the expenditure of ~~sparing~~ time and money needed ~~abused~~ for driving the air compressor 18 unnecessarily, and partly for preventing the ~~very~~ rare occurrence of dangerous oxygen-short air.

Soon after the driving of air compressor 18 is interrupted, driving of the submerged pump 9 installed in top well 6 bored into top permeable section 23 is commenced as illustrated in Figure 4.

By commencing ~~drive~~ the driving of the submerged pump 9, the groundwater in loose fine grained layer 2 is pumped out through branch water pipe 11, main water pipe 10, water check valve 12 and made to flow into air-tight tank 13.

The groundwater thus pumped out up into air-tight tank 13 flows after being stored to fill up air-tight tank 13, flows through reverse flow main pipe 14, into reverse flow branch pipe 15, into perforated pipe 16 down into deep granular layer 4.

Even though the amount of very fine particles pumped out of the loose fine grained layer 2 together with the water pumped out of submerged pump 9 is regulated to be minimized by water-flow sensor (not shown) linked electronically to submerged pump 9, it is

not able to prevent accumulating very fine dusty particles to form ~~clogging~~ clogs in the pore voids of deep granular layer 4.

~~As a result of the~~ The above clogging formed in deep granular layer 4~~, it~~ makes it more difficult for the pumped out water ~~harder~~ to permeate into deep granular layer 4, causing a decrease in the amount of water flowing into deep granular layer 4.

As soon as the water-flow sensor (not shown) linked electronically to the means driving the submerged pump 9 detects the decrease in flow rate to lower than a predetermined rate, driving of submerged pump 9 is interrupted.

Supply of compressed air is automatically resumed by starting to drive the air compressor 18 when the lowering of water pressure in air-tight tank 13 as the result of interruption of pumping groundwater out by submerged pump 9 is detected by the pressure sensor linked to electronically to the means of driving (not shown) air compressor 18.

The above resumed supply of compressed air raises the pressure in air-tight tank 13, opens main valve 17 in reverse flow main pipe 14, and feeds compressed air through reverse flow main pipe 14, reverse flow branch pipe 15, perforated pipe 16 and down to blow ~~blowing~~ out into deep granular layer 4.

The dusty particles mixed into the groundwater pumped out by thus pumping form ~~clogging~~ clogs in the pore voids of deep granular layer 4 surrounding bottom well 8 to decrease the amount of water flowing out into said deep water bearing layer 4.--

On page 30, please amend the fifth and sixth paragraphs as follows:

--~~During while~~ While said tap-water is prepared in regulating tube 28 and permeated into loose fine grained layer 2 as described above, the groundwater exuding out of deep granular layer 4 is drained into the nearest side ditch of street 1 after it flows up through the rows of reverse flow branch pipe 15 and reverse flow main pipe 14 laid across below the pavement of roadway in street 1.

As shown in Figures 9 through 12, shortly after the ~~said~~ tap-water prepared as described above is made permeate into the aerated pore voids of loose fine grained layer 2, the permeating front of said tap-water shown by bold chain lines draws out of the bottom ends of rows of top ~~well~~ wells 6 laid along each outer side ~~outside~~ of roadway of street 1.--

On page 31, please amend the third full paragraph beginning on line 12, as follows:

--By forming these countless tiny air bubbles crowding around said cores of micro particles of said mineral powder, ~~lower~~ the saturation degree in the loose fine grained layer 2 is lowered ~~done~~ to the level at which no seismic liquefaction takes place even at the time of a disastrously violent earthquake.--

On page 14, please amend the fifth full paragraph, beginning on line 32, as follows:

--In Figure 14, illustrated are container wharf 31, container crane 32, container vessel 33, and container 34. Because a container wharf 31 is usually built on a reclaimed ground and the tidal changing surface level of sea water varies with the location of harbors, any detail in dimension of sea water level above ground level (G.L) is not shown in Figure 14.--